TCEQ Interoffice Memorandum

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Date: November 6, 2017

Subject: Health Effects Review of 2016 Ambient Air Network Monitoring Data in Region 12, Houston

Key Points

- Only approximately 0.00016% of measured hourly concentrations exceeded an odor-based AMCV. A few hourly levels (e.g., isoprene, styrene) at three Region 12 sites could result in the perception of odors if people were exposed. Assuming exposure, the monitored concentrations would not be expected to cause direct, short-term adverse health effects (e.g., eye irritation), and the infrequency and generally low magnitude of the exceedances are not indicative of persistent, strong odors with the potential to cause odor-related health effects (e.g., nausea, headache).
- With the exception of hexachloro-1,3-butadiene and acetaldehyde, annual average concentrations for all other chemicals and metals from 24-hour measurements were below their respective TCEQ AMCVs.
    - At three Texas City/La Marque sites (2nd Ave, Ave A and North Site), the annual averages of hexachloro-1,3-butadiene exceeded the long-term health-based AMCV. At Ave A, the long-term average of acetaldehyde slightly exceeded the long-term health-based AMCV. These low magnitude exceedances would not be expected to cause long-term adverse health effects.
    - Eighteen of the measured 24-hour concentrations exceeded their odor-based AMCVs, which were at HRM 11, Avenue A, 2nd Avenue, and North Avenue. These monitored concentrations would not be expected to cause acute health effects.
- In August 2016, propionaldehyde was removed from the Air Pollutant Watch List (APWL) (Site# 1202) for Texas City based on improvements in available monitoring data, the updated propionaldehyde odor-based AMCV, and the significant changes Dow has made to its facility to reduce propionaldehyde emissions.
- In January 2017, benzene was removed from the APWL (Site# 1206) for Galena Park based on improvements in available monitoring data, reduction in reported benzene emissions in the area, and significant equipment and operational improvements by area companies.

Background

The primary purpose of this memorandum is to convey the Toxicology Division's (TD)

evaluation of ambient air toxics sampling conducted at monitoring sites in Region 12-Houston during 2016. The TD reviewed summary results for volatile organic compounds (VOCs) from 24-hour canister samples, 1-hour automated gas-chromatography (autoGC) VOC samples, 24- and 3-hour carbonyl samples, 24-hour polycyclic aromatic hydrocarbon (PAH)/semivolatile organic compound (SVOC) samples, 30-minute rolling averages of 1-hour hydrogen sulfide samples, 24-hour metals samples from filters designed to collect particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$) and from filters collecting particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}), and 24-hour lead total suspended particulate (TSP) samples.

Historically, this memorandum has evaluated data from the TCEQ and Enhanced Industry-Sponsored Monitoring (EISM) sites, which are reported to the TCEQ on a regular basis. For this memorandum, industry-sponsored air monitoring networks that are not routinely reported to the TCEQ are also included. The TD requested these data from the respective industry groups and included it in our evaluation, as detailed below. Except for lead, data for criteria pollutants (i.e., compounds having National Ambient Air Quality Standards (NAAQS)) were not evaluated for this memorandum. Appendix 1 contains a list of the target analytes evaluated for this review.

Information regarding monitoring sites and target analyte data reviewed by the TD is presented in Table 1 and summarized below:

- 24-hour canister VOC sampling at:
  - 12 TCEQ sites
  - 6 Houston Regional Monitoring (HRM) sites outside of the EISM sites, and
  - 3 Texas City/La Marque Community Air Monitoring Network (TCLAMN) sites.
- 24-hour carbonyl sampling at 2 sites.
- 3-hour carbonyl sampling at 1 site.
- 24-hour metals sampling at 4 sites. (Clinton (PM10) deactivated 12/31/2016; Houston Deer Park #2 (Lead TSP) deactivated 12/31/2016)
- 24-hour PAH/SVOC sampling at 1 site.
- 1-hour autoGC VOC sampling at:
  - 5 TCEQ sites,
  - 9 EISM sites (Texas City 11th St deactivated 7/31/2016),
  - 1 Harris County Health and Environmental Services site,
  - 1 TCLAMN site, and
  - 1 HRM site.
- 5-minute hydrogen sulfide (H_2S) sampling at:
  - 1 TCEQ site,
  - 2 EISM sites.

Table 1. Monitoring Sites Located in TCEQ Region 12

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
Galveston	N/A	2nd Avenue Monitoring Station (29.386981, -94.91912)	TCLAMN[1]	VOC (24-hour canister, 1/12 days[2]; autoGC)
Galveston	N/A	Avenue A Monitoring Station (29.37435, -94.96364)	TCLAMN	VOC (24-hour canister)
Harris	48-201-0058	Baytown 7201 ½ Bayway Dr	TCEQ	VOC (24-hour canister)
Harris	48-201-6000	Cesar Chavez 4829A Galveston Rd	TCEQ	VOC (autoGC)
Harris	48-201-0026	Channelview 1405 Sheldon Rd	TCEQ	VOC (autoGC)
Harris	48-201-1035	Clinton 9525 ½ Clinton Dr	TCEQ/City of Houston Health Department[3]	VOC (autoGC), Carbonyls[4]/ Metals (PM_{10})[5]
Brazoria	48-039-1003	Clute 426 Commerce St	TCEQ	VOC (24-hour canister)
Brazoria	48-039-0618	Danciger Along US Hwy 1459 in Brazoria County	EISM[6] - SI Group[7]	VOC (autoGC)
Brazoria	48-039-1012	Freeport South Ave I 207 South Avenue I	TCEQ	Metals ($PM_{2.5}$)
Harris	48-201-0057	Galena Park 304 Stewart St	Harris County	VOC (autoGC / 24-hour canister)

[1] TCLAMN – Texas City/La Marque Community Air Monitoring Network.
[2] The typical schedule for 24-hour canisters is to collect one 24-hour sample every six days. This sampler is collecting one 24-hour sample every twelve days.
[3] City of Houston Health Department owns and is responsible for the PM_{10} metals monitor at this site.
[4] This carbonyl sampler collects one 24-hour sample every six days from January through June and October through December. From July through September, this sampler switches to a more intensive sampling schedule where it collects eight 3-hour samples every three days.
[5] PM10 speciation deactivated at this site 12/31/2016
[6] EISM – Enhanced Industry-Sponsored Monitoring, this acronym is followed by the industry group responsible for the sampling.
[7] Sweeny Industry Group.

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
			HES[8] / TCEQ	
Harris	48-201-0024	Houston Aldine 4510 ½ Aldine Mail Rd	TCEQ	Metals ($PM_{2.5}$)
Harris	48-201-0055	Houston Bayland Park 6400 Bissonnet St	TCEQ	VOC (24-hour canister)
Harris	48-201-1039	Houston Deer Park #2 4514 ½ Durant St	TCEQ	VOC (autoGC, 24-hour canister), Carbonyls, Metals ($PM_{2.5}$, PM_{10}, Lead TSP[9]) , PAHs/SVOCs
Harris	48-201-0803	HRM #3 Haden Rd 1504 ½ Haden Dr	TCEQ/EISM - HRM[10]	VOC (24-hour canister)/VOC (autoGC)
Harris	N/A	HRM 1 Central Street 1501 Central Street, Houston	HRM	VOCs (24-hour canister)
Harris	N/A	HRM 4 Sheldon Rd 16200 Miller Road 1, Channelview	HRM	VOC (24-hour canister)
Harris	N/A	HRM 7 W Baytown 4606 W. Baker Rd, Baytown	HRM	VOC (24-hour canister)
Harris	N/A	HRM 8 LaPorte 11426 Fairmont Pkwy, La Porte	HRM	VOC (24-hour canister)
Chambers	N/A	HRM 10 Mont Belvieu 13618 Hatcherville Rd, Mont Belvieu	HRM	VOC (24-hour canister)
Chambers	N/A	HRM 11 E Baytown 8620 West Bay Rd, Baytown	HRM	VOC (24-hour canister)
Harris	N/A	HRM 16 Deer Park 601 East 8th Street, Deer Park	HRM	VOC (autoGC)

[8] Harris County Health and Environmental Services site; data from this site is reported directly to TCEQ.
[9] Lead TSP deactivated at this site 12/31/2016
[10] HRM – Houston Regional Monitoring.

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
Harris	48-201-0036	Jacinto Port 1st St and Elsbeth St	TCEQ	VOC (24-hour canister)
Brazoria	48-039-1016	Lake Jackson 109-B Brazoria Hwy 332-W	EISM – FI Group[11]	VOC (autoGC)
Harris	48-201-1015	Lynchburg Ferry 1001 B Lynchburg Rd	TCEQ/EISM - HRM	VOC (24-hour canister)/VOC (autoGC)
Harris	48-201-0307	Manchester/Central 9401 ½ Manchester Rd	TCEQ	VOC (24-hour canister)
Harris	48-201-0069	Milby Park 2201-a Central St	TCEQ	VOC (autoGC)
Galveston	N/A	North Site (29.429228, -94.971503)	TCLAMN	VOC (24-hour canister, 1/12 days)
Harris	48-201-1049	Pasadena North 702 Light Company Rd	TCEQ	VOC (24-hour canister)
Harris	48-201-0061	Shoreacres 3903 ½ Old Hwy 146	TCEQ	VOC (24-hour canister)
Galveston	48-167-0683	Texas City 11th St 569 11th Street South	EISM - Marathon Petroleum Co.	Benzene (autoGC)[12]
Galveston	48-167-0056	Texas City 34th St 2212 North 34th St	EISM - TCLAMN	VOC (autoGC)
Galveston	48-167-0005	Texas City Ball Park 2516 ½ Texas Ave	TCEQ	H_2S, VOC (24-hour canister)
Galveston	48-167-0615	Texas City BP 31st Street (Site 1) 302 31st Street South	EISM – Marathon Petroleum Co.	H_2S, 4 VOCs (autoGC)
Galveston	48-167-0621	Texas City BP Logan Street (Site 3) 303 Logan Street	EISM – Marathon Petroleum Co.	H_2S, 4 VOCs (autoGC)

[11] Freeport Industry Group.
[12] Texas City 11th St site deactivated 7/31/2016

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
Harris	48-201-0617	Wallisville Rd 4727 Wallisville Rd	EISM - HRM	VOC (autoGC)

All data collected at TCEQ monitors are analyzed by the TCEQ laboratory and should meet a 75% data completeness objective. At EISM monitors, data are collected by a third party contractor and should also meet a 75% data completeness objective. One-hour autoGC VOC and 3-hour carbonyl data were evaluated for potential acute health (e.g., irritation), odor, and vegetation concerns, as were any 24-hour sample results (e.g., VOCs, carbonyls, metals) that exceeded short-term air monitoring comparison values (AMCVs). Twenty-four-hour air samples collected every 6th day on a yearly basis are designed to provide representative long-term average concentrations. In order to be able to evaluate 24-hour monitoring data more fully, the TCEQ has developed 24-hour AMCVs for specific chemicals. As such, 24-hour samples were compared to the available TCEQ 24-hour AMCVs for the following:

- 1,3-butadiene
- 2,2-dimethylbutane
- 2,3-dimethylbutane
- 2-methylpentane
- 3-methylpentane
- acrolein
- benzene
- cadmium
- chromium
- cobalt
- crotonaldehyde
- ethylene dichloride
- formaldehyde
- n-hexane

However, because short-term or peak concentrations may be significantly different than 24-hour sample concentrations, daily concentrations have limited use in evaluating the potential for acute health effects. The annual averages from 1-hour autoGC and 24-hour samples (VOCs, carbonyls, and metals) were evaluated for potential chronic health and vegetation concerns. Measured chemical concentrations were compared to appropriate comparison values (e.g., the National Ambient Air Quality Standards (NAAQS) value, TCEQ health-, odor-, and vegetation-based AMCVs). Information on AMCVs may be obtained via the internet (http://www.tceq.texas.gov/toxicology/AirToxics.html#list) or by contacting the TD (512-239-3900). Exceedance of an AMCV does not necessarily mean that adverse effects would be expected, but rather that further evaluation is required.

Evaluation

1-Hour and 3-hour Concentrations

The vast majority of the 1-hour autoGC VOC concentrations were below their respective TCEQ short-term, health-, odor-, and/or vegetation-based AMCVs. For example, about 99.9998% of the approximately 4,512,670 1-hour VOC measurements from the TCEQ, EISM, Harris County Health and Environmental Services, and TCLAMN network autoGC monitors in Region 12 in 2016 were below their short-term AMCVs. Only eight (approximately 0.00017%) hourly autoGC measurements collected at these Region 12 monitors in 2016 exceeded a TCEQ short-term, health-based AMCV (see discussion below). Seven hourly measurements (approximately

0.00016%) exceeded an odor-based AMCV (Table 2).Additionally, 100% of the approximately 4,012 3-hour carbonyl concentrations measured in Region 12 in 2016 were below their respective AMCVs. Therefore, the TD would not expect short-term, adverse health effects, vegetation effects, or odors to be associated with the vast majority of 1-hour or 3-hour measurements monitored in Region 12 in 2016.

Further evaluation was conducted for the monitored concentrations that exceeded their respective short-term, health- and/or odor-based AMCVs to determine the potential for adverse health effects or odors. Seven concentrations of isoprene and one concentration of benzene were the only instances in which any of the monitored 1-hour concentrations exceeded their respective short-term, health-based AMCVs in 2016. The benzene exceedance of 276 ppb occurred at the Lynchburg Ferry site monitor and was above the current health-based AMCV of 180 ppb_v. This maximum monitored hourly benzene concentration is significantly below benzene levels attributable to short-term, adverse health effects such as central nervous system depression. Therefore, exposure to this 1-hour concentration would not be expected to cause short-term, adverse health effects. Four of the isoprene exceedances occurred at the Lynchburg Ferry site monitor, where hourly isoprene concentrations of 165.6, 53.5, 52.8, and 28.6 ppb_v were above the current interim short-term, health-based AMCV of 20 ppb_v. The other three isoprene exceedances occurred at the Dancinger, HRM#3 Haden Road, and HRM 16 monitoring sites, with concentrations of 20.8, 22.4, and 21 ppb_v, respectively. However, this short-term AMCV was simply designed to help ensure that the long-term average at a site remains low (i.e., < 2 ppb_v) as opposed to being a short-term concentration of actual potential health concern. The TCEQ is currently in the final stages of assessing the health hazards/risks of isoprene, including deriving a final health-protective, short-term AMCV more representative of the actual potential for short-term, adverse health effects. Using the latest scientific assessment methods, the final short-term, health-based AMCV will likely be at least an order of magnitude higher than the current interim value. In addition, these monitored hourly exceedances are significantly below isoprene levels attributable to short-term, adverse health effects. Therefore, exposure to these hourly concentrations would not be expected to cause short-term, adverse health effects.

The monitored 1-hour autoGC VOC concentrations that exceeded their respective odor-based comparison levels in 2016 are shown below in Table 2. The total number of odor-based AMCV autoGC exceedances in Region 12 in 2016 (7 exceedances) is slightly higher than the number of exceedances in 2015 and 2014 (5 exceedances each year), 13% lower than in 2013 (8 exceedances), 50% lower than in 2012 (14 exceedances), 63% lower than in 2011 (19 exceedances), and 91% lower than in 2010 (75 exceedances). Additionally, it is significantly lower compared to 2009 (37 exceedances), 2008 (82 exceedances), and 2007 (103 exceedances).

Table 2. Odor-Based AMCV Exceedances by 1-Hour AutoGC VOC Concentrations

Site	Chemical	Number of 1-Hour Concentrations above Odor-Based AMCV	Maximum Measured Concentration (ppb_v)	Odor-Based AMCV (ppb_v)
Lynchburg Ferry	Styrene	2	142.6	26
	Isoprene	3	165.6	47
Channelview	Styrene	1	44.7	26
HRM #3 Haden Road	Styrene	1	63.4	26

The monitored odor-based AMCV exceedances in 2016 would not be expected to cause direct acute adverse health effects (e.g., eye irritation). Additionally, the infrequency and generally low magnitude of the exceedances (e.g., < 3 times the odor-based AMCV except for one isoprene and one styrene concentration) are not indicative of persistent, strong odors with the potential to cause odor-related health effects (e.g., nausea, headache).

24-Hour Concentrations

All of the 24-hour measurements, for which there are 24-hour, chemical-specific AMCVs available, were below their health-based AMCVs in Region 12 in 2016. There were eighteen odor exceedances measured in canister samplers. At the HRM 11 site, one butyraldehyde concentration (12 ppb_v) exceeded the odor-based AMCV. At the three Texas City/La Marque air monitoring sites, a total of fifteen butyraldehyde concentrations (9.6 ppb_v -15 ppb_v) exceeded the odor-based AMCV (i.e., eleven at Ave A, one at 2nd Ave , and three at the North Site). In addition, two acetaldehyde concentrations (74 ppb_v -80 ppb_v) exceeded the odor-based AMCV at Ave A. These monitored concentrations would not be expected to cause direct acute health effects (e.g., eye irritation). Additionally, although the perception of sufficiently strong and persistent unpleasant odors has the potential to cause odor-related health effects (e.g., nausea, headache), these concentrations are not indicative of strong odors with the potential to cause odor-related health effects due to the likely conservative nature of the odor-based AMCVs, and low frequency and magnitude of the exceedances (all samples were < 2 times the odor-based AMCVs). The monitored 24-hour VOC concentrations that exceeded their respective odor-based comparison levels in 2016 are shown below in Table 3.

Table 3. Odor-Based AMCV Exceedances by 24-Hour VOC Concentrations

Site	Chemical	Number of 1-Hour Concentrations above Odor-Based AMCV	Maximum Measured Concentration (ppb_v)	Odor-Based AMCV (ppb_v)
HRM 11	Butyraldehyde	1	12	9.1
Avenue A	Acetaldehyde	2	80	67
	Butyraldehyde	11	14	9.1
2nd Avenue	Butyraldehyde	1	11	9.1
North Site	Butyraldehyde	3	15	9.1

Annual Average Concentrations

In 2016, all annual averages were below their respective long-term AMCVs for the seventh consecutive year in many years of sampling in Region 12, except for hexachloro-1,3-butadiene at three Texas City/La Marque Sites (2nd Ave, Avenue A, and North Site) and acetaldehyde at Avenue A.

- Based on the approximately 5,804 24-hour metals measurements, all monitored annual average concentrations of metals were below their respective long-term comparison values (e.g., long-term AMCVs);
- Based on the approximately 1,819 24-hour measurements, all annual average concentrations of carbonyls were also below their respective long-term AMCVs;
- Based on approximately 1,840 24-hour measurements, all annual average concentrations for PAHs/SVOCs were below long-term AMCVs; and
- Based on averages from approximately 105,347 24-hour canister measurements and approximately 4,512,670 hourly autoGC measurements (TCEQ, EISM, Harris County Health and Environmental Services, HRM, and TCLAMN network autoGC sites), all annual VOC concentrations were also less than their respective long-term AMCVs, with the exception of two chemicals (hexachloro-1,3-butadiene at three Texas City/La Marque Sites (2nd Ave, Avenue A, and North Site) and acetaldehyde measured at the Avenue A monitoring site).
    - The long-term averages of hexachloro-1,3-butadiene at three sites [2nd Ave (0.08 ppb_v), Ave A (0.09 ppb_v), and North Site (0.08 ppb_v)] may exceed the long-term health-based AMCV of 0.020 ppb_v. However, the method detection limit (MDL), which is the minimum concentration of a chemical the laboratory would measure and report with 99% confidence that the analyte concentration is greater than

zero, for this chemical is approximately 0.166 ppb_v and is above the long term-health- AMCV. In addition, twenty-six of the thirty (26/30) samples collected at 2nd Ave were non-detects, fifty-two of the fifty nine samples (52/59) at Ave. A were not detected, and thirty of the thirty-one (30/31) samples at the North Site were non-detects. Therefore, the sampling and analytical techniques currently used do not achieve a sufficiently low MDL for comparison of long-term averages predominantly driven by non-detects to the current long-term AMCV and regardless, these "exceedances" would not likely cause adverse health effects.

- The annual average of 27.5 ppb_v for acetaldehyde at the Avenue A monitoring site is slightly above the long-term AMCV of 25 ppb_v. However, TCEQ's comparison values are not threshold concentrations for health effects, and adverse health effects would not be expected to occur based on a thorough evaluation of the reported results and scientific toxicological data.

In conclusion, 99.99998% of all annual averages were below their respective long-term AMCVs and no long-term, adverse health or vegetation effects would be expected due to exposure to those concentrations.

Delisting of Galena Park APWL Area for Annual Benzene Concentrations

As of January 2017, benzene was removed from the APWL (Site# 1206) for Galena Park. Several factors supported the delisting of benzene from the Galena Park area. APWL 1206 was originally established in 2000 to address elevated annual benzene concentrations measured at the Galena Park canister monitor. Since 2008, annual average benzene concentrations at the Galena Park monitor have declined and remained below the long-term AMCV of 1.4 ppbv. Additionally, collocated validated autoGC data collected from December 2011 through November 2012 and May 2015 through June 2016 were well below the long-term AMCV for benzene. Additional benzene monitoring data from the Galena Park area have shown annual concentrations below the long-term AMCV of 1.4 ppbv since 2009, including the Pasadena North, Clinton, Manchester/Central, and Milby Park monitoring sites. At the same time, reported benzene emissions in the Galena Park APWL 1206 have decreased substantially since its listing on the APWL. Companies in the Galena Park area have implemented significant equipment and operational improvements to contribute to the reduction of emissions. Based on the available monitoring data and other information (e.g., reductions by area companies), benzene was delisted from the APWL.

Delisting of Texas City APWL Area for Propionaldehyde Concentrations Exceeding the 1-hour Odor-based AMCV.

As of August 2016, propionaldehyde was removed from the APWL (Site# 1202) for Texas City. Several factors supported the delisting of propionaldehyde from the Texas City area. This APWL area was listed based on mobile monitoring, where concentrations of propionaldehyde were detected above the historical (i.e., prior to September 2015) odor-based AMCV (then 9 ppb_v) downwind of Dow Chemical. The AMCVs for many odorous pollutants, including propionaldehyde, have been recently updated to more appropriately assess odor nuisance conditions rather than mere potential detection of an odor. The odor-based AMCV for

propionaldehyde was updated from 9 ppbv to 40 ppbv. In addition, Dow has made significant changes to its facility to reduce propionaldehyde emissions and reduce the potential for odor nuisance conditions from existing propionaldehyde sources. Moreover, Dow's 2014 ambient monitoring study did not measure any concentrations at or above the current odor-based AMCV. Furthermore, there were no complaint incidents (e.g., for odors) or complaint investigations related to Dow Chemical in Texas City from 2010 through 2015. Based on the available monitoring data, the updated AMCVs (e.g., odor-based AMCV), and other information (e.g., reductions by Dow, complaint history), propionaldehyde was delisted from the APWL.

Freeport APWL Area for Arsenic, Cobalt, Nickel, & Vanadium Concentrations Exceeding Short-Term, Health-based AMCVs.

Elevated short-term nickel, arsenic, vanadium, and cobalt levels exceeding their respective AMCVs were measured near Gulf Chemical and Metallurgical Corporation in Freeport during yearly mobile monitoring trips conducted 2005-2010. Due to the elevated metals concentrations, the Freeport area (Site# 1201) was added to the APWL in 2005. In May of 2011, the Freeport South Avenue I monitoring site was activated. This site is located northeast of the facility of concern, within a residential area, and monitors for speciated $PM_{2.5}$ metals. Since this site's activation in May of 2011, 100% of all speciated $PM_{2.5}$ metals short-term and annual averages have been below their respective AMCVs; no adverse health effects would be expected due to exposure to these concentrations. The TCEQ will continue to evaluate relevant air monitoring data and any additional information for this APWL site within the context of the APWL protocol.

If you have any questions regarding this memorandum, please contact Joseph T. Haney, Jr., M.S. by phone at (512) 239-5691 or by email at Joseph.Haney@tceq.texas.gov,or Tracie Phillips, Ph.D. by phone at (512) 239-2269 or by email at Tracie.Phillips@tceq.texas.gov. For questions regarding the APWL, you may visit the TCEQ website at https://www.tceq.texas.gov/toxicology/apwl/apwl-index.html.

Appendix 1. Monitored Air Toxics in Region 12 in 2016

List 1. Target VOC Analytes in Canister Samples*

1,1,2,2-Tetrachloroethane	Acetylene	Methylcyclopentane
1,1,2-Trichloroethane	Acrolein – Verified [a,b,c]	m-Ethyltoluene
1,1-Dichloroethane	Benzene	n-Butane
1,1-Dichloroethylene	Bromomethane	n-Decane
1,2,3-Trimethylbenzene	Carbon Tetrachloride	n-Heptane
1,2,4-Trimethylbenzene	Chlorobenzene	n-Hexane
1,2-Dichloropropane	Chloroform	n-Nonane
1,3,5-Trimethylbenzene	Chloromethane	n-Octane
1,3-Butadiene	cis-1,3-Dichloropropene	n-Pentane
1-Butene [b]	cis-2-Butene	n-Propylbenzene
1-Hexene & 2-Methyl-1-Pentene [b]	cis-2-Hexene	n-Undecane
	cis-2-Pentene	o-Ethyltoluene [b]
1-Pentene	Cyclohexane	o-Xylene
2,2,4-Trimethylpentane	Cyclopentane	p-Diethylbenzene
2,2-dimethylbutane [b]	Cyclopentene	p-Ethyltoluene
2,3,4-Trimethylpentane	Dichlorodifluoromethane	Propane
2,3-Dimethylbutane	Dichloromethane [b]	Propylene
2,3-Dimethylpentane	Ethane	Styrene
2,4-Dimethylpentane	Ethylbenzene	Tetrachloroethylene [b]
2-Chloropentane [b,c]	Ethylene	Toluene
2-Methyl-2-Butene [c]	ethylene dibromide [b]	trans-1,3-Dichloropropene
2-Methylheptane	ethylene dichloride [b]	trans-2-Butene
2-methylhexane [b]	Isobutane	trans-2-Hexene
2-methylpentane [b]	Isopentane	trans-2-Pentene
3-Methyl-1-Butene	Isoprene	Trichloroethylene
3-Methylheptane	Isopropylbenzene [b]	Trichlorofluoromethane
3-Methylhexane	m-Diethylbenzene	Vinyl Chloride
3-Methylpentane	Methyl Chloroform [b]	
4-Methyl-1-Pentene	Methylcyclohexane	

* See Lists 6 and 7 for additional canister analytes monitored only at the industry-sponsored air monitoring network sites (TCLAMN & HRM non-EISM network sites).
[a] Only measured at Houston Deer Park #2 monitoring site.
[b] Not monitored at the HRM 1, 4, 7, 8, 10 and 11 sites.
[c] Not monitored at the TCLAMN 2nd Avenue, Avenue A, and North sites.

List 2. Target Carbonyl Analytes

2,5-Dimethylbenzaldehyde	Benzaldehyde	Heptanal
Acetaldehyde	Butyraldehyde	Hexanaldehyde
Acetone	Crotonaldehyde	Isovaleraldehyde
Acrolein - Unverified	Formaldehyde	Methyl Ethyl Ketone (MEK)

Methacrolein	Propionaldehyde	m & p-Tolualdehyde
o-Tolualdehyde	Valeraldehyde	

List 3. Target Metal Analytes

Aluminum ($PM_{2.5}$, PM_{10})	Cobalt ($PM_{2.5}$, PM_{10})	Selenium ($PM_{2.5}$, PM_{10})
Antimony ($PM_{2.5}$, PM_{10})	Copper ($PM_{2.5}$, PM_{10})	Tin ($PM_{2.5}$, PM_{10})
Arsenic ($PM_{2.5}$, PM_{10})	Lead ($PM_{2.5}$, PM_{10}, TSP [a])	Vanadium ($PM_{2.5}$)
Barium ($PM_{2.5}$, PM_{10})	Manganese ($PM_{2.5}$, PM_{10})	Zinc ($PM_{2.5}$, PM_{10})
Cadmium ($PM_{2.5}$, PM_{10})	Molybdenum ($PM_{2.5}$, PM_{10})	
Chromium ($PM_{2.5}$, PM_{10})	Nickel ($PM_{2.5}$, PM_{10})	

[a] Only monitored at the Houston Deer Park #2 monitoring site; TSP = total suspended particulate.
$PM_{2.5}$ metals are monitored at the Freeport South Avenue I, Houston Aldine, and Houston Deer Park #2 monitoring sites.
PM_{10} metals are monitored at the Clinton and Houston Deer Park #2 monitoring sites.

List 4. Target PAH Analytes

Acenaphthene	Benzo(g,h,i)perylene	Indeno(1,2,3-cd)pyrene
Acenaphthylene	Benzo(k)fluoranthene	Naphthalene
Anthracene	Chrysene	Phenanthrene
Benzo(a)anthracene	Dibenzo(a,h)anthracene	Pyrene
Benzo(a)pyrene	Fluoranthene	
Benzo(b)fluoranthene	Fluorene	

List 5. Target VOC Analytes in AutoGC

1,2,3-Trimethylbenzene	Acetylene [b]	Toluene [e]
1,2,4-Trimethylbenzene	Benzene [c,e,f]	cis-2-Butene
1,3,5-Trimethylbenzene	Cyclohexane	cis-2-Pentene
1,3-Butadiene [c]	Cyclopentane	m/p Xylene
1-Butene [b]	Ethane	n-Butane
1-Pentene	Ethylbenzene	n-Decane
2,2,4-Trimethylpentane	Ethylene [b]	n-Heptane
2,2-Dimethylbutane [b]	Isobutane	n-Hexane [e]
2,3,4-Trimethylpentane	Isopentane	n-Nonane
2,3-Dimethylpentane	Isoprene	n-Octane
2,4-Dimethylpentane	Isopropylbenzene [b]	n-Pentane [e]
2-Methyl-2-Butene [a]	Methylcyclohexane	n-Propylbenzene
2-Methylheptane	Methylcyclopentane	n-Undecane [a]
2-Methylhexane [b]	Propane	o-Xylene
3-Methylheptane	Propylene	trans-2-Butene
3-Methylhexane	Styrene	trans-2-Pentene

[a] Only monitored at the Danciger, HRM #3 Haden Rd., HRM 16 Deer Park, Lake Jackson, Lynchburg Ferry, Texas City 34th St., and Wallisville Rd. monitoring sites.
[b] Not monitored at the HRM 16 Deer Park monitoring site.
[c] 2nd Avenue Monitoring Station only monitored for these componds, in addition to those listed in List 8.
[e] These are the only compounds monitored at the TX City BP Logan and TX City BP 31st sites.
[f] This is the only compound monitored at the TX City 11th St site.

List 6. Additional Canister Analytes Monitored at TCLAMN sites

1,1,2-trichloro-1,2,2-trifluoroethane	2,4,4-Trimethyl-1-Pentene	Butyl Acrylate
1,2,4-Trichlorobenzene	2,4,4-Trimethyl-2-Pentene	Butyl benzene
1,2-dichloro-1,1,2,2-tetrafluoroethane	2,5-Dimethylhexane	Butyraldehyde
1,4-Dioxane	2-Ethyl-1-Butene	Chlorodifluoromethane
1-Butanol	2-Methyl-2-Pentene	Chloroethane
1-Decene	Acetaldehyde	Chloroprene
1-Heptene	Acetone	cis-1,2-Dichloroethylene
1-Methylcyclopentene	Acetonitrile	cis-2-Octene
1-Nonene	Acrylonitrile	cis-3-Hexene
1-Octene	alpha-Pinene	cis-3-Methyl-2-Pentene
1-Propanol	Benzaldehyde	cis-4-Methyl-2-Pentene
1-Undecene	Benzyl Chloride	Cyclohexene
2,2,3-Trimethylpentane	beta-Pinene	Dichlorofluoromethane
2,2,5-Trimethylhexane	Bromochloromethane	Diethyl Ether
	Bromodichloromethane	dimethylethyl benzene
	Bromoform	Ethanol

heptaldehyde	m-Dichlorobenzene	o-Dichlorobenzene
Hexachlorobutadiene	Methanol	para-cymene
hexanaldehyde	methyl cyclohexene	p-Chlorotoluene
Indane	methyl ethyl ketone	p-Dichlorobenzene
Indene	Methyl isobutyl ketone	trans-1,2-Dichloroethylene
Isobutyl benzene	Methyl tert-Butyl ether	Vinyl Acetate
isopropanol	Naphthalene	Vinyl Bromide
m/p-xylene	Neopentane	

List 7. Additional Canister Analytes Monitored at HRM sites

1-Hexene	Butyl Acrylate	Dichlorofluoromethane
1-Methylcyclohexene	Butyraldehyde	Naphthalene

List 8. Additional AutoGC Analytes Monitored at 2nd Avenue Monitoring Station

Vinyl Chloride